CMP 445-INTRODUCTION TO ARTIFICIAL INTELLIGENCE

MODULE 1 INTRODUCTION

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COURSE OUTLINE

- Introduction to Artificial Intelligence, Understanding Natural Languages, Knowledge Representation Logic-based knowledge representation, Expert Systems, Pattern recognition agents: Problem Solving as Search; search Strategies; Breadth first, Depth first, uniform cost, depth constraint, satisfaction problems, Backtracking, Search for CSP, Constraint Propagation Local Search for CSPs.
- Knowledge representation; Reasoning with Inference; Reasoning with uncertainty; Approximate Reasoning; Expert System Design; Case Studies.

LECTURE PLAN

Week	Topics	Assignments
1	Introduction to Artificial Intelligence	Assignment #1: Analysis of definitions of A.I and Turing Test
2-5	Pattern recognition agents: Problem Solving as Search; search Strategies; Breadth first, Depth first, uniform cost, depth constraint, satisfaction problems, Backtracking, Search for CSP, Constraint Propagation Local Search for CSPs.	Assignment #2: Implementations of Search Strategies Test #1
6-7	Knowledge Representation Techniques: Object-Attribute-Value Triplet, Semantic Networks, Frames Logic-based knowledge representation	Assignment #3: KRT
8	Reasoning with Knowledge: Reasoning with Inference; Reasoning with uncertainty; Approximate Reasoning;	

LECTURE PLAN ..

Week	Topics	Assignments
9	Expert Systems, Expert System Design; Case Studies.	Test #2
10-12	A.I. Languages	Assignment #4: Representing knowledge in Prolog and LISP
13	Revision	

RECOMMENDED TEXTS

1. Artificial Intelligence – A System's Approach by M. Tim Jones (2008)
2. Artificial Intelligence - A Guide to Intelligent Systems by Michael Negnevitsky (2005)
3. Artificial Intelligence Illuminated by Ben Copin (2004)

WHAT IS INTELLIGENCE?

- Intelligence is described in various ways:
- We can define intelligence as a set of properties of the mind, which include the ability to plan, solve problems, and in general, reason.
- A simpler definition could be that intelligence is the ability to make the right decision given a set of inputs and a variety of possible actions.
  - The second definition means we can apply intelligence not only to humans, but also to animals that exhibit rational behavior.
  - But the intelligence that is exhibited by human beings is much more complex than that of animals.
    - For example, humans have the ability to communicate with language, but so do some animals.
    - Humans can also solve problems, but the same can be said of some animals.

WHAT IS INTELLIGENCE?..

- One difference then is that humans embody many aspects of intelligence (the ability to communicate, solve problems, learn and adapt) where animals typically embody a small number of intelligent characteristics, and usually at a much lower level than humans.

WHAT IS ARTIFICIAL INTELLIGENCE?

- The goal of AI is to develop machines that behave as though they were intelligent (John McCarthy, 1955) – very simplistic!
- AI is the ability of digital computers or computer controlled robots to solve problems that are normally associated with the higher intellectual processing capabilities of humans … (Encyclopedia Britannica)
  - This definition is also weak; It would admit for example that a computer with large memory that can save a long text and retrieve it on demand displays intelligent capabilities, for memorization of long texts can certainly be considered a higher intellectual processing capability of humans, as can for example the quick multiplication of two 20-digit numbers.
  - According to this definition, then, every computer is an AI system.

WHAT IS A.I.?..

- This dilemma is solved elegantly by the following definition by Elaine Rich [Ric83]:

  Artificial Intelligence is the study of how to make computers do things at which, at the moment, people are better.

TURING TEST

- In 1950, Alan Turing asked whether a machine could think.
- Turing not long before had introduced the concept of his universal abstract machine (called the *Turing Machine*) that was simple and could solve any mathematical problem (albiet with some complexity).
- Building on this idea, Turing wondered that if a computer's response were indistinguishable from a human, then the computer could be considered a thinking machine.
- The result of this experiment is called the *Turing Test*.

TURING TEST..

- In the Turing test, if the machine could fool a human into thinking that it was also human, then it passed the intelligence test.
- One way to think of the Turing test is by communicating to the other agent through a keyboard.
- Questions are asked of the peer through written text, and responses are provided through the terminal.
- This test provides a way to determine if intelligence was created.
- Considering the task at hand, not only must the intelligent peer contain the necessary knowledge to have an intelligent conversation, it must be able to parse and understand natural language and generate natural language responses.
- The questions may involve reasoning skills (such as problem solving), so mimicking humans would be a feat!

A.I. IN PRACTICE

- A.I. is the design and study of computer programs that behave intelligently.
- This programs are constructed to perform as would a human or an animal whose behaviour we consider intelligent.
- A.I. systems can perform a wide range of purposes.
  - There are programs that
    - generate investment strategies by predicting trends in the stock market,
    - diagnose patient illnesses, suggesting treatments, and
    - control assembly robots in factories
  - A.I. systems are used to
    - Plan routes of airlines
    - Build cars in factories and
    - Play master-level chess.

A.I. IN PRACTICE..

- A.I. is the basis of a host of other practical systems, some of them already existing while others are being designed for future.
- **Language translation systems: -** that you can speak to and have them print transcripts of what you say in foreign language. More advanced ones can answer questions based on the information in the text and produce summaries.
- **Air traffic control systems:** tracking thousands of flights, personnel, and maintenance schedule, though difficult for man, had been handled by AI systems which schedule arrival and departure of flights to maximize passenger safety and minimize delays.

A.I. IN PRACTICE..

- **Supervisory systems:** - In a large office building, a supervisory AI system can control elevators, power and climate conditions. It can also manage security and safety inspections and direct visitors to their destinations.
- **Automated personal assistants:** AI systems can manage and guide in the use of network. It can search through your mails and call your attentions to the most important mails.
- **Intelligent highways:** AI systems can be built to optimise the usage of existing highways by broadcasting traffic warnings, redirecting vehicles to alternative streets, and controlling the speed and spacing of vehicles.
- **Robots for hazardous conditions:** Robots can be built to handle hazardous tasks that may be dangerous to human beings.
- A.I Engineers are responsible for building A.I. systems.

A.I. THEORY

- AI is more than an engineering discipline; It is also a subject for scientific investigation.
- Researchers construct theories about what AI programs are capable of and test them with mathematical analyses or experiments.
- What adaptations are possible for those that learn from experience?
- How can systems change in response to new information?
- What kind of training should a learning program receive?
  - Scientists in AI are developing general computational theories to answer these questions and others.

A.I. THEORY..

- Theories are subjected to examinations analytically by developing mathematical abstractions and proving theorems.
- They are also studied empirically by developing programs, running experiments, and analysing the results.
- Examples of AI Theories:
  - Inferring structure from motion in machine vision (MV) – MV is concerned with interpreting information contained in electronic camera images.
  - Finding consistent hypotheses in learning – given a set of examples of a target concepts and finding a hypothesis describing the concept that is consistent with the examples it has seen so far.
  - Probabilistic inference in diagnostic reasoning – in medical diagnosis, networks involving probabilities are used to infer the most likely disease from a patient's symptoms.
  - Parsing sentences in language understanding – parsing reveals the structure of sentences and it is an important step in automated language understanding.

ASSIGNMENTS

1. Trace the historical development of A.I. in not more than 3 pages. Cite relevant references.
2. Give five practical definitions of A.I. and briefly comment on each. Cite the source of each definition.
3. Survey and document any three practical implementation of the Turing Test. Cite relevant references and include diagrams.